INSULATOR DEPARTMENT

GENERAL ELECTRIC

BALTIMORE, MARYLAND

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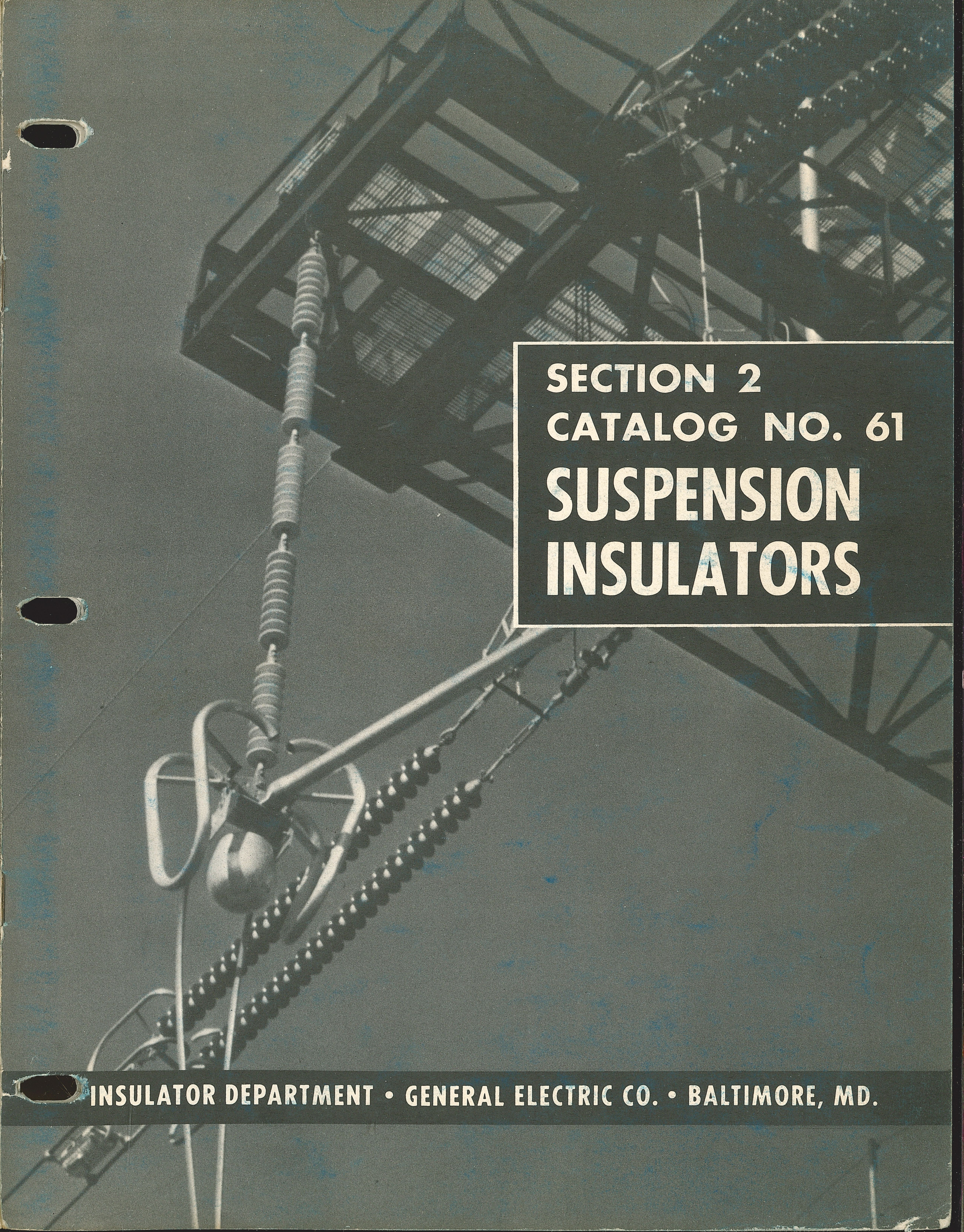

SECTION 2
CATALOG NO. 61
SUSPENSION INSULATORS

INSULATOR DEPARTMENT • GENERAL ELECTRIC CO. • BALTIMORE, MD.

SUSPENSION INSULATORS

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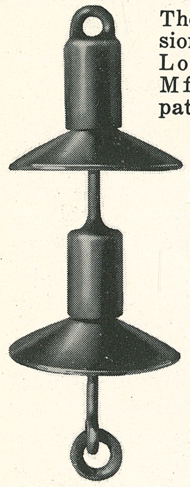
Cover Photo: GEPOL Polymer Suspension Insulators on General Electric's Project EHV in Pittsfield, Mass.

* Trademark of General Electric Co.

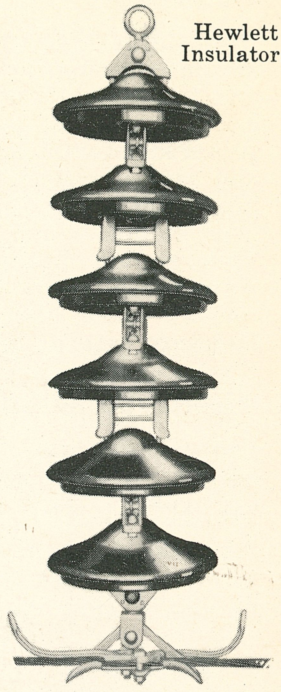
HISTORY


The first Suspension Insulator — Locke Insulator Mfg. Company patent — 1904.

By 1905 or 1906, transmission voltages of over 100,000 volts required larger insulators than could practically be built into a single pin-type unit with the requisite mechanical and electrical properties. While something remotely resembling the modern suspension insulator had been developed for dead-ending high voltage conductors as early as 1902, it found little practical use. These very earliest suspension units consisted of two conical shells, interspersed with unitary metal parts, cemented to form a strain insulator which supported the load in tension rather than in compression and cantilever as the pin-type units (see illustration).

1906 saw the first cap and pin type and Hewlett suspension insulator, used on the first 110 KV lines built. The cap and pin type units consisted of two cemented porcelain shells, to which a clevis type cap and a split eye bolt pin were cemented. Some of these may still be found on high voltage transmission lines.

Demand for a suspension insulator without cement spurred the invention in 1905 and 1906 of the Hewlett type suspension insulator (above, right), whose load bearing metal parts interlinked each other at right angles, with insulating layers of porcelain between them. The porcelain parts worked in compression. This ingenious design was first used at 110 KV and was popular for many years. Many thousands of these units are still giving excellent service.

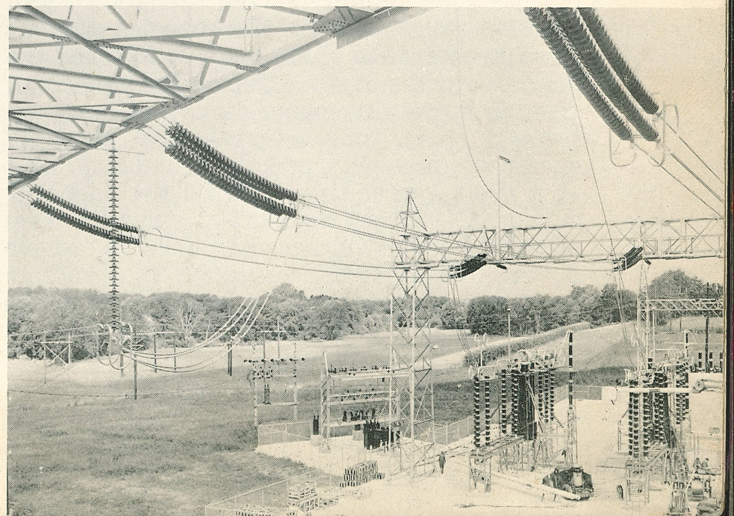

Hewlett Insulators

Simplicity of manufacture and freedom from radio noise required by the advent of radio, brought about the wide use of cap and pin type suspension insulators. In the early units, breakage was caused when the cap was assembled to rest directly on the shell or skirt of the insulator. To eliminate this difficulty, Locke Insulator Mfg. Co. developed the gasket assembly, now universally used. A gasket used in cementing, later removed, leaves a clear space between cap and insulator shell.

DESIGN FEATURES

Millions of Locke* suspension insulators are in service on transmission lines throughout the world under all conceivable operating conditions. Since the first suspension insulator was produced by Fred M. Locke in 1904, to the introduction of the new GEPOL Polymer Insulator in 1963 (see page 14), they have been continually improved. Only recently, the M&E strength ratings on all Locke transmission insulators have been upgraded to give the most advanced and reliable insulator in the world.

* Registered trademark of the General Electric Co.


The old and the new—Barely visible in background appears 115KV transmission line compared with General Electric's Project EHV (extra high voltage) 750 KV line.

SUSPENSION INSULATORS

PORCELAIN

Proper thickness and soundness of porcelain are determining factors in resisting puncture and mechanical breakage. In the design of Locke suspension insulators, balance is achieved between required puncture strength and needed mechanical strength. The most important part of the porcelain shell is the head section which is enveloped by the cap. This section bears the mechanical loads transmitted from pin to cap through the cement. Here, also, electrical gradients and puncture hazards are greatest.

IMPROVED IMPULSE CHARACTERISTICS

Properly designed suspension insulators exhibit remarkable resistance to damage from over voltage. They will, under most practical conditions, withstand repeated application of flashover voltages, either 60 cycle or impulse, without damage other than surface "burning". Nonetheless, it is possible to puncture suspension insulators by the application of impulse voltages having very steep wave fronts and high magnitude. Furthermore, it has been found that in some cases insulators which have been subjected, without failure, to high voltage at steep wave fronts suffer permanent damage. This can be detected by a subsequent 60 cycle puncture test under oil. The probable explanation of this behavior may be understood by reference to Figure 1. This shows schematically volt time curves for "A", the air gap around an insulator (the flashover gap), and "B", the volt time curves for the solid dielectric (the breakdown gap thru the porcelain). If these curves cross at some hypothetical point, such as P_0, then the insulator will puncture before flashing over. If such a crossing point occurs, it is at extremely short time intervals and probably does not represent a practical condition. But at a much longer time interval the flashover curve "A" crosses the critical puncture level at point P_1. For voltages on Curve "A" above P_1 the insulators are subjected to a voltage such that if maintained a longer time puncture would occur. Under these conditions it is possible to cause permanent electrical damage to the insulator without actually puncturing it. Extensive testing in the high voltage laboratory has resulted in an optimized design which maximizes the resistance of Locke suspension insulators to steep wave front punctures. Figure 2 shows the result of tests made on the new Locke insulator shell compared to results of the same tests on shells of conventional design. Five applications of steep wave front impulses at an applied rate of rise of 8000 kv per microsecond were applied to each group. This is admittedly very severe testing and impulse applications of this order were used to accelerate the deterioration for time conservation purposes as well as to be certain that levels were used which were not likely to be exceeded under natural environment. Following the steep wave front test the insulators were punctured under oil at 60 cycles. This chart graphically demonstrates a significant improvement in steep wave front impulse puncture resistance provided by the Locke insulator shell design.

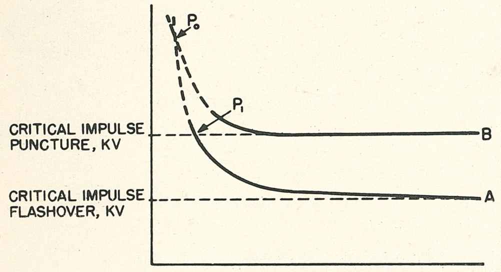


Figure 1
Why Insulator Punctures Occur.

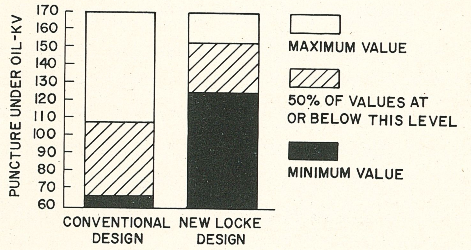


Figure 2

INSULATOR HARDWARE

Caps, clevis and ball bolts are aluminum, galvanized forged steel or malleable iron. Cotter pins are high grade copper alloy and are of the humped type, self-locking to simplify hotline work.

The metal bolt is designed with an offset area for the transmittal of load from the bolt to the cement within the pin hole.

The lip section of the metal cap, which envelopes the porcelain head, is formed at an optimum angle to control the direction of load transmission between cement and cap. When the cap is cemented to the porcelain, a clearance is left between its lip and the porcelain surface. This eliminates porcelain breakage due to differential expansion of cap and porcelain shell.

LONG TIME STRENGTH

Locke suspension insulators provide for the maintenance of initial high mechanical strength throughout the life of the units.

It has been known for many years that suspension insulators dissipate some portion of their initial strength with the passage of time. The reasons for this strength depreciation were obscure and research in this area has been complicated by the long test cycles necessary to develop data from test specimens.

Rigorous mathematical investigation and practical experiment demonstrated the significant parameters which would apply to the problem resulting in the development of Locke suspension insulators which maintain their initial high mechanical strength indefinitely.

One of the major factors in long time strength was determined to be the asphalt coating universally used on metal parts exposed to cement. The general functions required of the coating are:

1. For protection of galvanizing against uncured cement.
2. For a thermal relief barrier compensating for varying thermal coefficients of expansion.
3. For load redistribution and uniform loading of hardware parts, following physical changes such as cement shrinkage, etc.

It was shown that the load redistribution function was particularly critical. Asphalt compounds commonly used have the property of providing "lubrication" between hardware and cement surfaces on initial application, but a gradual decay of this property is immediately recognized in its aging process. It becomes brittle, shows a loss of resilience and is easily removed from the surface on which it was applied. Deterioration of this coating alone can result in a loss of M&E strength of as much as 30% over extended periods.

Type of Coating	Percent M & E Strength		
	Short-time (7 days)	Long-time (1 year)	Thermal Load Test
No coating	100	100	100
Old coating	150	120	105
New coating	157	170	168

Comparative M & E strengths of insulators under Varying Time and Test Conditions. Thermal load test corresponds to extended field service.

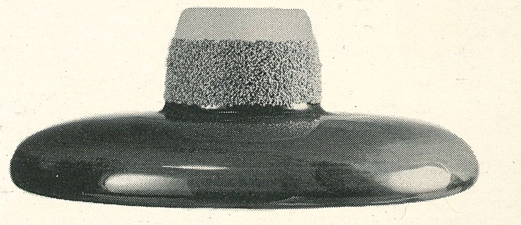
Figure 3

To combat this loss of strength a radically new coating—Material X—is now being applied to all Locke suspension insulators. This material provides the full protection necessary for galvanized surfaces, allows uniform load transfer, provides an effective thermal relief barrier, and retains its initial high lubricating characteristics for an indefinite period of time, through a wide range of temperatures.

The Locke insulator you buy today lives up to its original specifications—continues to give you unvarying strength as long as you keep it in service.

SAND BELTS

Sanded areas on the head section and in the pin hole provide a locking medium for the transmission of mechanical loads from the porcelain surface to the cement (see photo). The special sand consists of ceramic granules, bonded to the porcelain surface by glaze.



OUTER SKIRT

The skirt section provides sufficient separation between cap and pin to withstand normal line to ground voltage and switching and lightning surges without flashover. Protected corrugations and hoods increase the surface leakage distance by increasing the length of the path over which leakage currents must flow. This reduces the probability of arc streamer formation developing into flashovers.

SUSPENSION INSULATORS

STRING ASSEMBLY

Connections between suspension units are made by means of caps and pins. The ball of the pin is inserted into the T-shaped recess of the cap until the upper area of the ball is seated in the matching contour of the cap. The spread cotter key in the cap is then driven forward. This gives a positive lock and prevents accidental separation of the units. Suspension insulators in each package are fully joined and ready for installation.

STRING LENGTH AT STRAIN POINTS

Points of strain such as dead-end or large angle structures are usually most important to the structural stability of the line. These are often located where safety is especially important—at road and railroad crossings, or where other utilities are crossed. At these points, you can least afford mechanical or electrical failure. Since electrical troubles are often followed by mechanical troubles, longer strings are recommended in the strain position than at regular suspension points.

Flashover values, both 60 cycle dry and impulse, for insulator strings in the strain position are less than those for the same string length in the vertical position. The sagging of horizontal strings reduces their arcing distance. (See Fig. 4.)

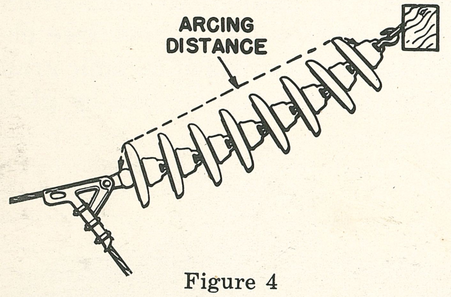


Figure 4
Sag of horizontal string reduces arcing distance.

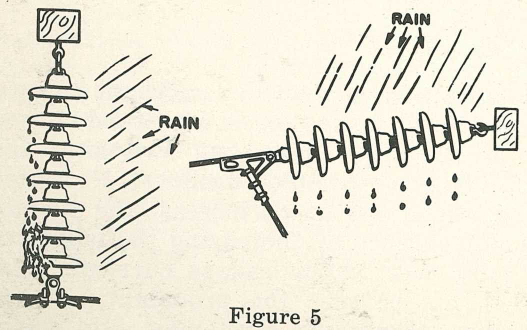


Figure 5
On strain string (right), no rain accumulation or bridging occurs.

Distortion of the electrostatic field at the line end of strain strings where changes in direction of the conductor are involved, results in 8 to 10% reduction in the 60 cycle dry and impulse flashover values of strings in the horizontal position.

Under wet conditions, drip water does not accumulate on a horizontal string as it does on a vertical string. This produces higher 60 cycle wet flashover values than those of a vertical string. The 60 cycle wet flashover value of a horizontal string is only slightly lower than its 60 cycle dry flashover value. (See Fig. 5.)

FOG TYPE INSULATORS

DESIGN CHARACTERISTICS

LONG, PROTECTED LEAKAGE DISTANCE—Half of entire 17″ effective leakage distance is on protected under side of insulator where entrapped warmth tends to dissipate fog and moisture. Deep corrugations on under side act as barriers, damping ionization and minimizing streamer formation. This reduces both audible and radio noise.

INCREASED IMPACT STRENGTH RATING results from improved design. High impact and mechanical strength is maintained by careful control of glaze uniformity and thickness.

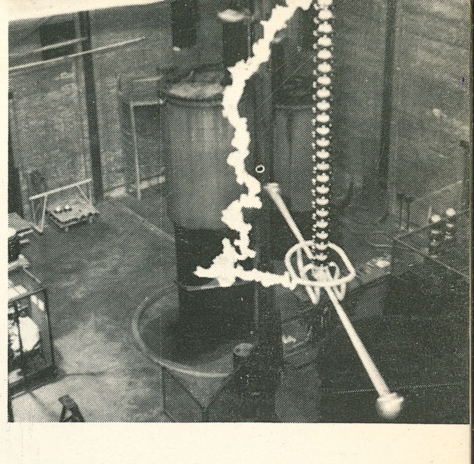
WIDE SPACING between units makes string assembly and cleaning in service much easier. REDUCED NET WEIGHT lessens installation cost.

WIDER SPACING between skirts and between shells of adjacent units breaks up rain drip, reducing tendency to bridge over. This results in fewer flashovers, less radio noise and more reliable line operation.

RADIO INFLUENCE VOLTAGE is well below standard ASA ratings under standard test conditions.

15
7.5

TESTS



Extensive flashover tests in the Baltimore High Voltage Laboratory help determine number of insulators in high voltage suspension assemblies.

MECHANICAL AND ELECTRICAL (M & E) TESTS

The combined mechanical and electrical strength rating of a suspension insulator is assigned by the manufacturer to indicate the combined mechanical and electrical strength of the unit. It is the loading in pounds at which any part of the insulator fails to perform its function either electrically or mechanically, when voltage and mechanical stresses are applied simultaneously.
(Ref. ASA C-29.2 & ASA C-29.1-1961).

The specified testing procedure requires that:

(a) The tensile load shall be applied between the terminal fittings in line with the axis of the specimen.
(b) The load shall be increased rapidly to 75 percent of rated insulator strength and beyond this point increased from 15 to 30 percent of rated strength per minute to failure.
(c) Simultaneously with the mechanical load, a voltage of commercial frequency equal to 75% of the dry flashover rating shall be applied.

PUNCTURE TESTS

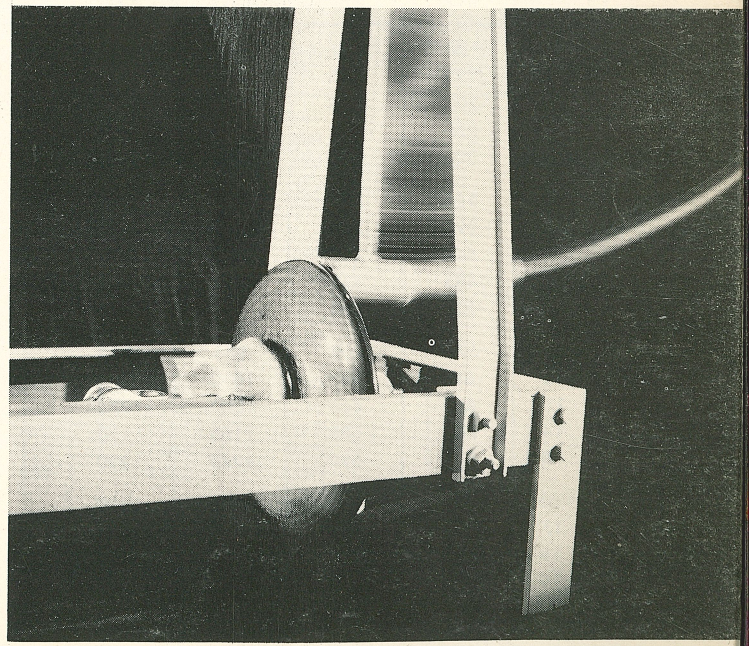
The puncture voltage is the voltage at which the tested unit will puncture. Puncture tests are performed only on fully assembled insulators. The unit is inverted and fully immersed in 6 inches of insulating oil of sufficient dielectric strength to prevent external flashover before puncture occurs. The voltage applied between cap and pin is raised to the rated dry flashover voltage of the insulator and then raised at the rate of approximately 10 KV every 15 seconds until puncture occurs.

IMPACT TESTS

The impact strength of an insulator is the blow in inch pounds which it can withstand without chipping, breaking, cracking or other damage. For this test, an impact machine illustrated below is used.

The insulator is mounted under tension of approximately 2000 lbs. A pendulum is so adjusted that when released, a copper nosed hammer will strike the outer rim of the shell squarely in a direction parallel to the axis of the unit, towards the cap. The insulator is struck a blow of specified severity in inch pounds by raising the pendulum until its shaft is opposite the corresponding inch pound mark of the indicating scale and releasing it. After receiving the blow, the unit is subjected to momentary flashover to discover any invisible damage. This test was initially introduced here in Baltimore and is now the standard of the industry (ASA C-29.2-1961).

Impact test on 10″ suspension insulator.



SUSPENSION INSULATORS

STRING FLASHOVER CHARACTERISTICS

4¼″ Diameter-6¼″ Spacing

No. of Units	Nos. 16044 and 16046				Radio Influence Voltage Data	
	Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave		Test KV RMS to Ground	Maximum Microvolt at 1000 Kc.
	Dry KV.	Wet KV.	Pos. KV.	Neg. KV.		
1	60	30	90	90	7.5	50
2	115	55	200	180	10	50

6″ Diameter-5½″ Spacing

No. of Units	Nos. 16083, 16583 and 17583			
	Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave	
	Dry KV.	Wet KV.	Pos. KV.	Neg. KV.
1	60	30	100	100
2	115	55	200	180
3	165	80	290	260

7½″ Diameter-5¾″ Spacing

No. 5875			
Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave	
Dry KV.	Wet KV.	Pos. KV.	Neg. KV.
65	35	115	115
125	60	210	210
180	90	300	300

Radio Influence Voltage Data	
Test KV RMS to Ground	Maximum Microvolt at 1000 Kc.
7.5	50
10	50
15	100

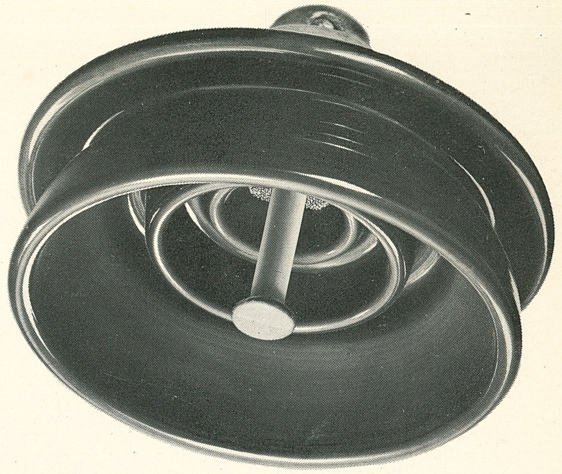
9″ & 10″ Diameter-5″ Spacing

No. of Units	Nos. 15S408, 20S845 and 30S254			
	Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave	
	Dry KV.	Wet KV.	Pos. KV.	Neg. KV.
1	80	50	125	130
2	145	85	240	235
3	200	120	335	320
4	250	155	420	395
5	300	190	495	465
6	345	225	570	535
7	390	260	645	610
8	440	295	720	680
9	485	330	790	760
10	530	365	865	840
11	575	400	935	915
12	615	435	1010	995
13	660	465	1080	1075
14	700	500	1155	1150
15	745	530	1225	1230
16	785	565	1295	1310
17	825	595	1365	1385
18	865	625	1435	1465
19	905	660	1505	1545
20	945	690	1575	1620

9″ & 10″ Diameter-5¾″ Spacing

Nos. 15S409, 15S410, 20S840, 20S580, 30S255, 30S257 and 40S360			
Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave	
Dry KV.	Wet KV.	Pos. KV.	Neg. KV.
80	50	125	130
155	90	250	250
215	130	355	340
270	170	440	415
325	215	525	495
380	255	610	585
435	295	695	670
485	335	780	760
540	375	860	845
590	415	945	930
640	455	1025	1015
690	490	1105	1105
735	525	1185	1190
785	565	1265	1275
830	600	1345	1360
875	630	1425	1445
920	660	1505	1530
965	690	1585	1615
1010	720	1665	1700
1055	750	1745	1785

Radio Influence Voltage Data	
Test RMS to Ground	Maximum Microvolts at 1000 Kc.
10	50
25	100
40	200
50	200
60	200
70	200
80	500
85	500
90	500
95	500
NOT ASSIGNED	



LOW-FREQUENCY AND IMPULSE FLASHOVER VALUES are average and are subject to the tolerances given under paragraphs headed "Probable Variations Applying to These Tests" in ASA Standard C-29.1-1961.

THE RADIO INFLUENCE VALUES given apply only to new insulators tested in the factory and are the maximum microvolt ratings when tested at the indicated test voltage to ground. The tests are made in accordance with the current NEMA-EEI-RMA recommendations on methods of measuring radio noise, NEMA Publications No. 107, and ASA Standard C-29.1-1961. The low frequency RMS test voltage values are approximately 10% higher than the line to ground voltage at which these insulators are usually operated.

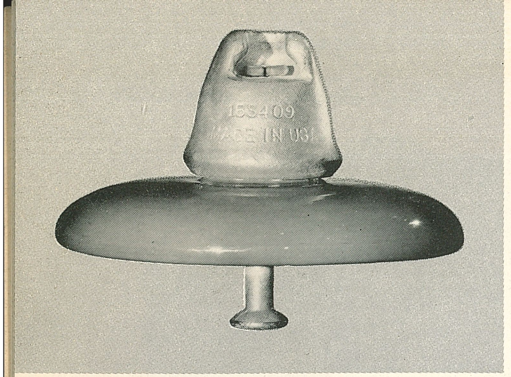
10½″ Diameter-5¾″ Spacing (Fog Type)

No. of Units	Nos. 18135, 18169, 18177, 18235 and 18237			
	Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave	
	Dry KV.	Wet KV.	Pos. KV.	Neg. KV.
1	100	60	195	180
2	160	95	290	270
3	220	135	380	355
4	275	175	475	435
5	335	215	570	520
6	390	250	665	605
7	440	290	750	690
8	490	330	835	775
9	540	365	920	860
10	590	400	1005	950
11	635	435	1090	1040
12	680	465	1175	1130
13	730	500	1260	1220
14	775	535	1345	1310
15	820	570	1430	1400
16	865	605	1515	1490
17	910	635	1600	1585
18	955	670	1685	1670
19	1000	705	1770	1755
20	1040	735	1850	1840

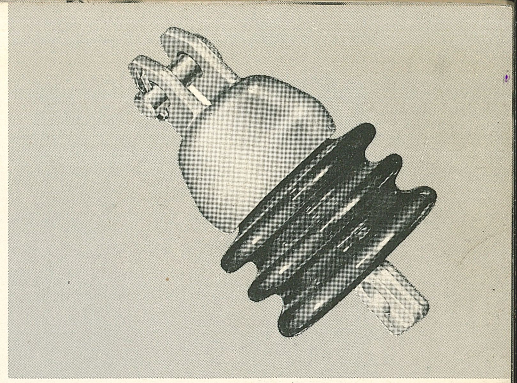
10½″ Diameter-6½″ Spacing (Fog Type)

Nos. 18134, 18168, 18136, 18234 and 18236			
Low Frequency Flashover		Impulse Flashover 1½ x 40 MS. Wave	
Dry KV.	Wet KV.	Pos. KV.	Neg. KV.
100	60	195	180
175	105	305	290
240	145	420	390
305	190	525	475
365	235	625	565
425	275	720	665
480	315	815	760
540	360	910	865
595	400	1010	965
650	440	1105	1070
700	480	1200	1170
755	520	1300	1270
805	560	1395	1375
855	595	1490	1475
905	635	1585	1580
955	670	1680	1680
1005	710	1770	1780
1055	750	1865	1880
1105	785	1960	1980
1150	820	2050	2085

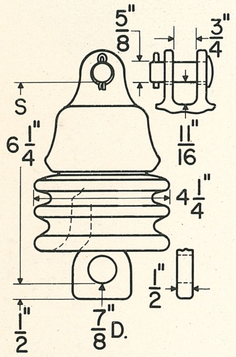
Radio Influence Voltage Data	
Test KV RMS. to Ground	Maximum Microvolts at 1000 Kc
10	50
25	100
40	200
50	200
60	200
70	200
80	500
85	500
90	500
95	500
NOT ASSIGNED	



SUSPENSION INSULATORS



10,000 LBS. M & E



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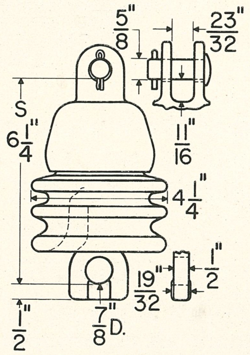
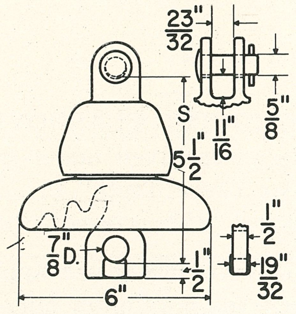


NO. 16046
ALUMINUM HARDWARE



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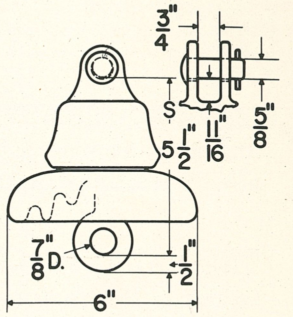
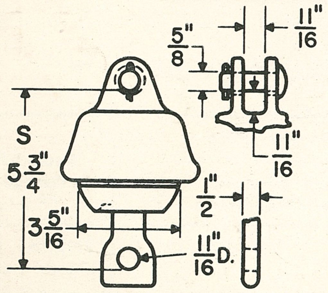


NO. 16583
17583 (Rugged)

15,000 LBS. M & E



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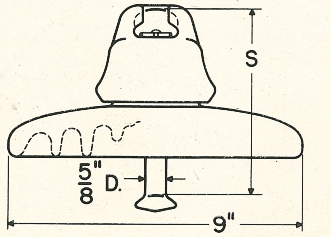
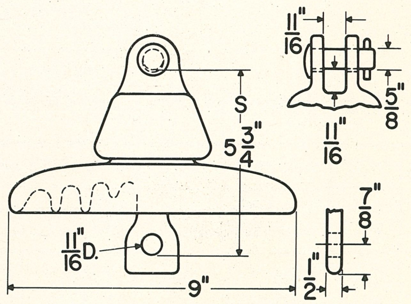


NOS. 15S408
15S409



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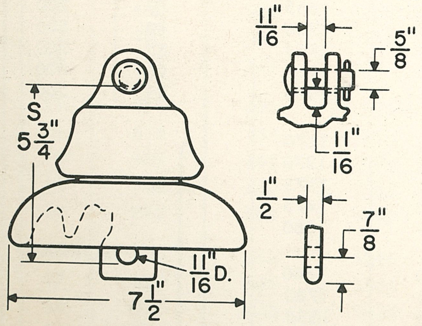
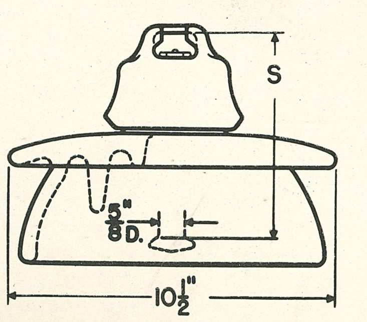
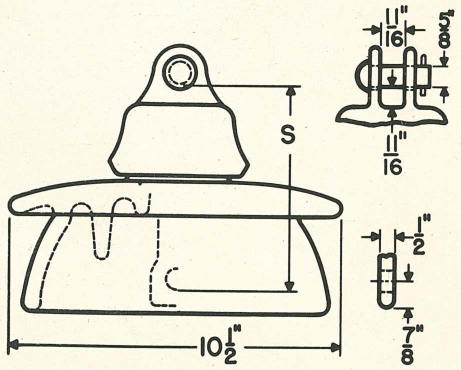


NO. 5875



NOS. 18134
18135
18168
18169



NOS. 18136
18177

Nos. 16044 and 16046 are rugged, resistant to damage in handling, and are adaptable for use with insulating goods in hot line installation.

Nos. 16083, 16583 and 17583 are ideal for dead-ending and angles on distribution circuits up to 13KV, ungrounded, and may also be used as a single insulator dead-end at low voltage and in strings for higher voltages.

No. 17583 insulator provides the industry's first 120 in. lb. impact strength. This new unit brings together the time-proven design of our standard 6", 10,000 lb., distribution shell and the industry's highest strength wet process porcelain body.

No. 18028 is used to insulate overhead ground wires from the tower structure. Should lightning occur, because of its low impulse flashover value, insulator will not isolate wire from structure.

No. 5875 replaces 16583 for higher conductor tensions and where higher flashover values are desired.

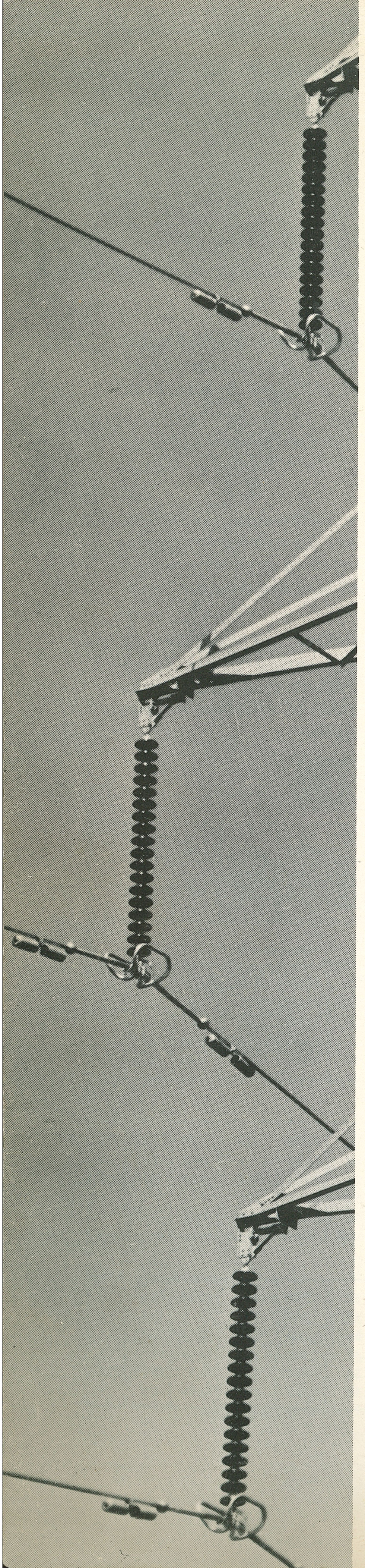
The new 9" diameter, lightweight, 15,000 lb. units are recommended for normal transmission applications, substation applications, and most sub-transmission and distribution dead-end requirements.

Locke fog-type insulators are specially designed for operation in areas where heavy fog, salt spray or industrial contamination demands maximum ratio of *effective* leakage distance to string length.

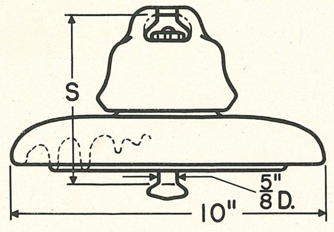
Shell Diameter, Inches	S Spacing Inches	Type Connector	LOCKE Catalog Number	ASA Class	Rec. Max. Working Load Lbs.	Impact Strength Inch-Lbs.	Leakage Distance Inches	Flashover—KV Low Frequency Dry	Flashover—KV Low Frequency Wet	Flashover—KV Impulse 1½ x 40MS Wave Pos.	Flashover—KV Impulse 1½ x 40MS Wave Neg.	Dry Arcing Dist. Inches	Radio Influence Voltage Test KV RMS to Ground	Radio Influence Voltage Max. Micro-volt at 1000Kc	Routine Proof Test Load, Pounds	Low Frequency Puncture Voltage, KV	Approx. Lbs. Each Net	Approx. Lbs. Each Pkd.	Std. Pkg. Quan.
10,000 POUNDS M & E																			
4¼	6¼	Clevis	16044	—	5,000	45	7	60	30	100	90	4	7.5	50	5,000	110	5.75	6	12
4¼	6¼	Clevis	*16046	—	5,000	45	7	60	30	100	90	4	7.5	50	5,000	110	3.75	4	12
6	5½	Clevis	*16083	—	5,000	90	7	60	30	100	100	4⅛	7.5	50	5,000	80	4	4.25	12
6	5½	Clevis	16583	52-1	5,000	90	7	60	30	100	100	4⅛	7.5	50	5,000	80	5.58	5.75	12
6	5½	Clevis	17583	52-1	5,000	120	7	60	30	100	100	4⅛	7.5	50	5,000	80	6.33	6.50	12
15,000 POUNDS M & E																			
3⁵⁄₁₆	5¾	Clevis	18028	—	7,500	—	1½	25	10	45	40	1½	—	—	7,500	110	5.75	6.25	12
7½	5¾	Clevis	5875	52-2	7,500	50	8¼	65	35	115	115	5½	7.5	50	7,500	90	8.75	9.45	8
9	5	B&S	15S408	—	7,500	90	11½	80	50	125	130	7¾	10	50	7,500	110	7.75	8.75	6
9	5¾	B&S	15S409	†52-3	7,500	90	11½	80	50	125	130	7¾	10	50	7,500	110	8	9	6
9	5¾	Clevis	15S410	†52-4	7,500	90	11½	80	50	125	130	7¾	10	50	7,500	110	8.25	9.25	6
15,000 POUNDS M & E - FOG TYPE																			
10½	6½	B&S	18134	—	7,500	55	17	100	60	195	180	9⅝	10	50	7,500	130	15.25	16.6	5
10½	5¾	B&S	18135	—	7,500	55	17	100	60	195	180	9⅝	10	50	7,500	130	15	16.25	5
10½	6½	B&S	**18168	—	7,500	55	17	100	60	195	180	9⅝	10	50	7,500	130	15.13	16.48	5
10½	5¾	B&S	**18169	—	7,500	55	17	100	60	195	180	9⅝	10	50	7,500	130	14.88	16.13	5
10½	6½	Clevis	18136	—	7,500	55	17	100	60	195	180	9⅝	10	50	7,500	130	15.5	16.85	5
10½	5¾	Clevis	18177	—	7,500	55	17	100	60	195	180	9⅝	10	50	7,500	130	15.25	16.5	5

* Aluminum hardware.
** Stainless steel ball bolts.
† Nos. 15S409 and 15S410 are equal in electrical characteristics to ASA standards.
LOKGARD lead sleeve (see p. 13) is available on all transmission insulators.

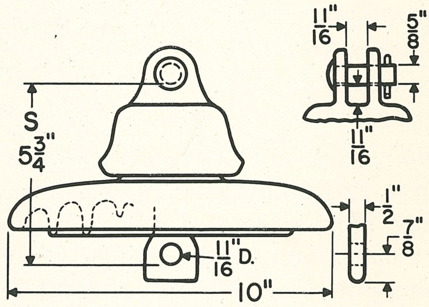
SUSPENSION INSULATORS



20,000 LBS. M & E

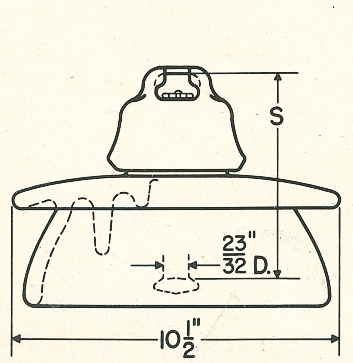


**NOS. 20S840
20S845**

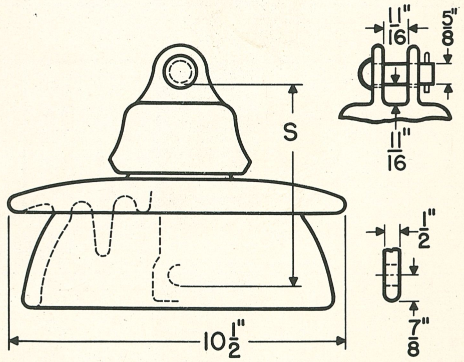


NO. 20S580

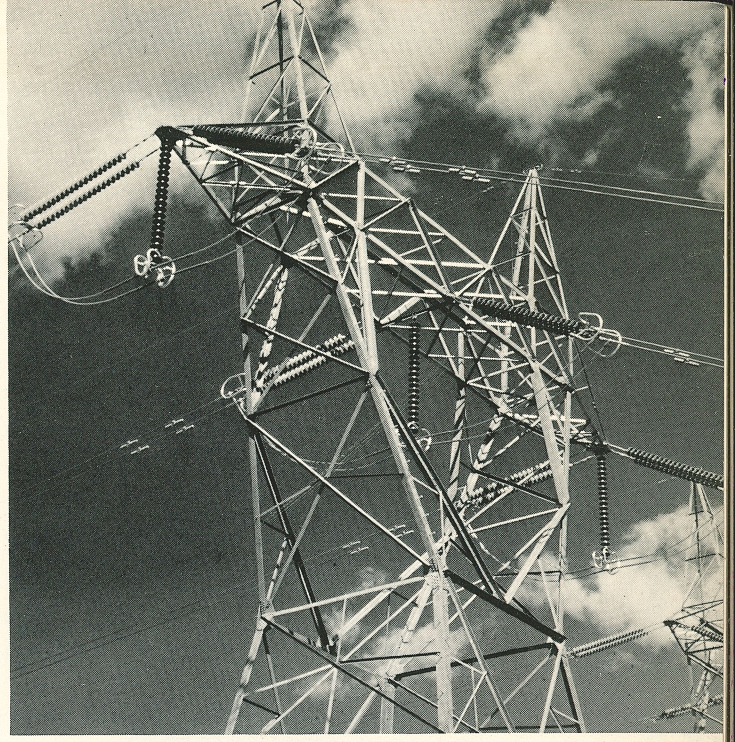
25,000 LBS. M & E
FOG TYPE



**NOS. 18234 &
18235**



**NOS. 18236
18237**



A few of the 155,000 Locke suspension insulators on the Arizona Public Service Co.'s 345KV Four Corners Line.

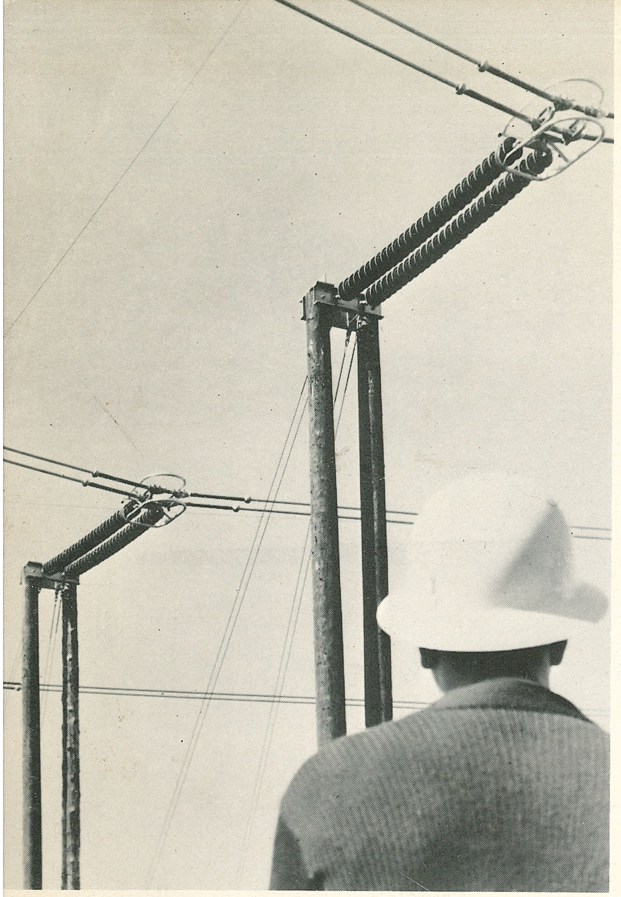
The heavy-duty Locke 20,000 lb. insulators are mechanically interchangeable with former 15,000 and 25,000 lb. units (5/8" ball bolt) and give extra reliability and safety over standard units. These new insulators give excellent service on larger or bundled conductor EHV lines.

Locke fog-type insulators are specially designed for operation in areas where heavy fog, salt spray or industrial contamination demand maximum ratio of *effective* leakage distance to string length.

Shell Diameter, Inches	S Spacing Inches	Type Connector	LOCKE Catalog Number	ASA Class	Rec. Max. Working Load Lbs.	Impact Strength Inch-Lbs.	Leakage Distance Inches	Flashover—KV				Dry Arcing Dist. Inches	Radio Influence Voltage		Routine Proof Test Load, Pounds	Low Frequency Puncture Voltage, KV	Approx. Lbs. Each		Std. Pkg. Quan.
								Low Frequency		Impulse 1½ x 40MS Wave			Test KV RMS to Ground	Max. Micro-volt at 1000Kc			Net	Pkd.	
								Dry	Wet	Pos.	Neg.								
20,000 POUNDS M & E																			
10	5¾	B&S	**20S840**	*52-3	10,000	90	12	80	50	125	130	7¾	10	50	10,000	110	10.5	11.5	6
10	5	B&S	**20S845**	—	10,000	90	12	80	50	125	130	7¾	10	50	10,000	110	10.25	11.25	6
10	5¾	Clevis	**20S580**	*52-4	10,000	90	12	80	50	125	130	7¾	10	50	10,000	110	10.75	11.75	6
25,000 POUNDS M & E - FOG TYPES																			
10½	6½	B&S	**18234**	—	12,500	90	17	100	60	195	180	9⅝	10	50	12,500	130	16.75	18.10	5
10½	5¾	B&S	**18235**	—	12,500	90	17	100	60	195	180	9⅝	10	50	12,500	130	16.5	17.75	5
10½	6½	Clevis	**18236**	—	12,500	90	17	100	60	195	180	9⅝	10	50	12,500	130	17	18.35	5
10½	5¾	Clevis	**18237**	—	12,500	90	17	100	60	195	180	9⅝	10	50	12,500	130	16.75	18	5

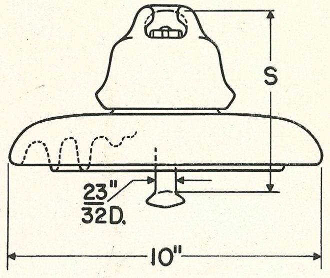
* Nos. 20S840 and 20S580, in addition to meeting all requirements in ASA standards, give you a bonus in M&E strength over standard 15,000 lb. units.
LOKGARD lead sleeve (see p. 13) is available on all transmission insulators.

SUSPENSION INSULATORS

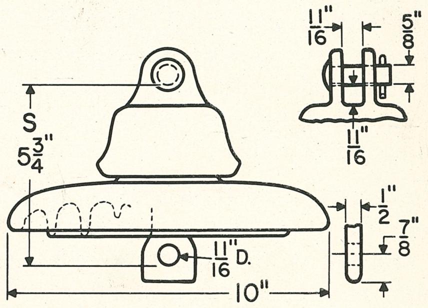


Flying line angle insulator assemblies containing 28–25,000 lb. (now upgraded to 30,000 lbs.) insulator units per string. Assemblies designed and built by the Insulator Dept. for the Pennsylvania Electric Company's 500KV EHV transmission line.

30,000 LBS. M & E

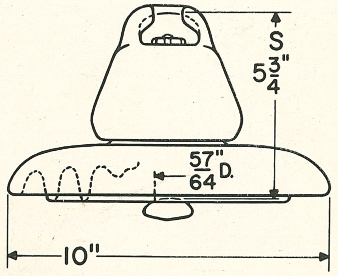


Nos. 30S254
30S255

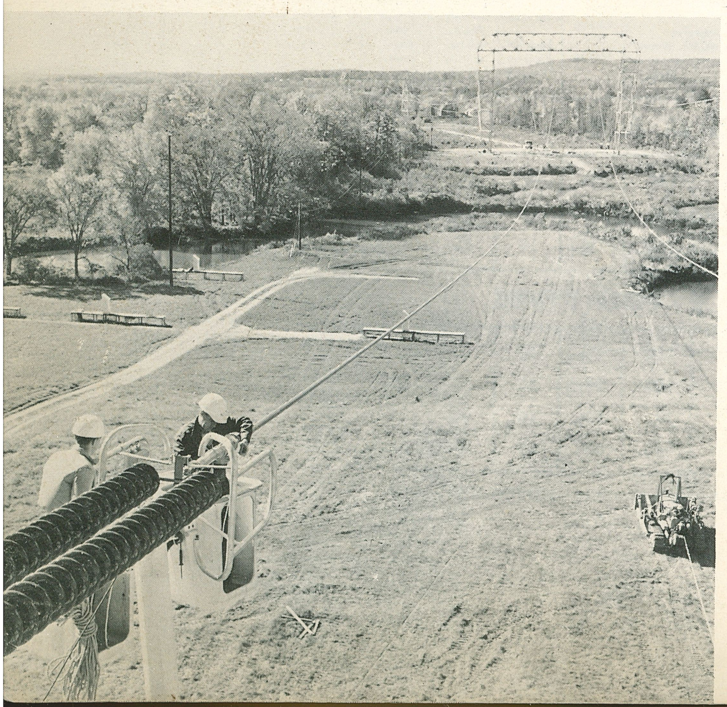


NO. 30S257

40,000 LBS. M & E



No. 40S360



Linemen complete installation of a dead-end suspension insulator assembly on General Electric's Project EHV 750KV line in Pittsfield, Mass. Outsize aluminum cables, thick as a man's wrist, require high strength 36,000 lb. (now upgraded to 40,000 lbs.) insulator assemblies to insure reliable operation under all possible weather conditions.

The new Locke 30,000 lb. insulators offer a 20% increase in M&E strengths over standard 25,000 lb. units. They can often be used to eliminate yokes, when suspending heavy lines on long spans, river crossings or for dead-ending where high strength is needed. No. 40S360, previously rated at 36,000 lbs., is still the finest that can be obtained with this new rating. There are few loads or problems that cannot be handled with this insulator. A principal use is on strain or large angle towers and on special crossing structures where ultra-high strength is required. In bundled conductor applications, No. 40S360 makes it possible to dead-end each of the conductors on individual insulator strings.

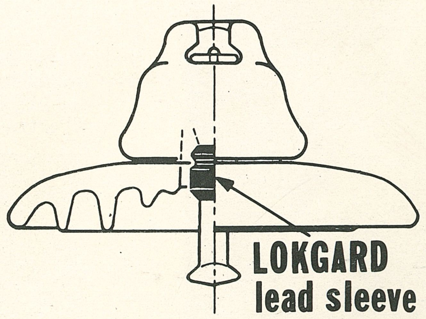
The hardware is *not* interchangeable with the 30,000 lb. ball and socket insulator as it is larger and more ruggedly designed to properly utilize the increased strength of the porcelain shell.

Shell Diameter, Inches	S Spacing Inches	Type Connector	LOCKE Catalog Number	ASA Class	Rec. Max. Working Load Lbs.	Impact Strength Inch-Lbs.	Leakage Distance Inches	Flashover—KV Low Frequency Dry	Flashover—KV Low Frequency Wet	Flashover—KV Impulse 1½ x 40MS Wave Pos.	Flashover—KV Impulse 1½ x 40MS Wave Neg.	Dry Arcing Dist. Inches	Radio Influence Voltage Test KV RMS to Ground	Radio Influence Voltage Max. Micro-volt at 1000Kc	Routine Proof Test Load, Pounds	Low Frequency Puncture Voltage, KV	Approx. Lbs. Each Net	Approx. Lbs. Each Pkd.	Std. Pkg. Quan.
30,000 POUNDS M & E																			
10	5	B&S	30S254	—	15,000	90	12	80	50	125	130	7¾	10	50	15,000	110	11.75	12.75	6
10	5¾	B&S	30S255	*52-5	15,000	90	12	80	50	125	130	7¾	10	50	15,000	110	12	13	6
10	5¾	Clevis	30S257	*52-6	15,000	90	12	80	50	125	130	7¾	10	50	15,000	110	12.75	13.25	6
40,000 POUNDS M & E																			
10	5¾	B&S	40S360	—	20,000	90	11½	80	50	125	130	7½	10	50	20,000	110	15.38	16.38	6

LOKGARD lead sleeve (see below) is available on all transmission insulators.

LOKGARD SLEEVE

Anti-Corrosive Device Available on Any Locke Suspension Insulator



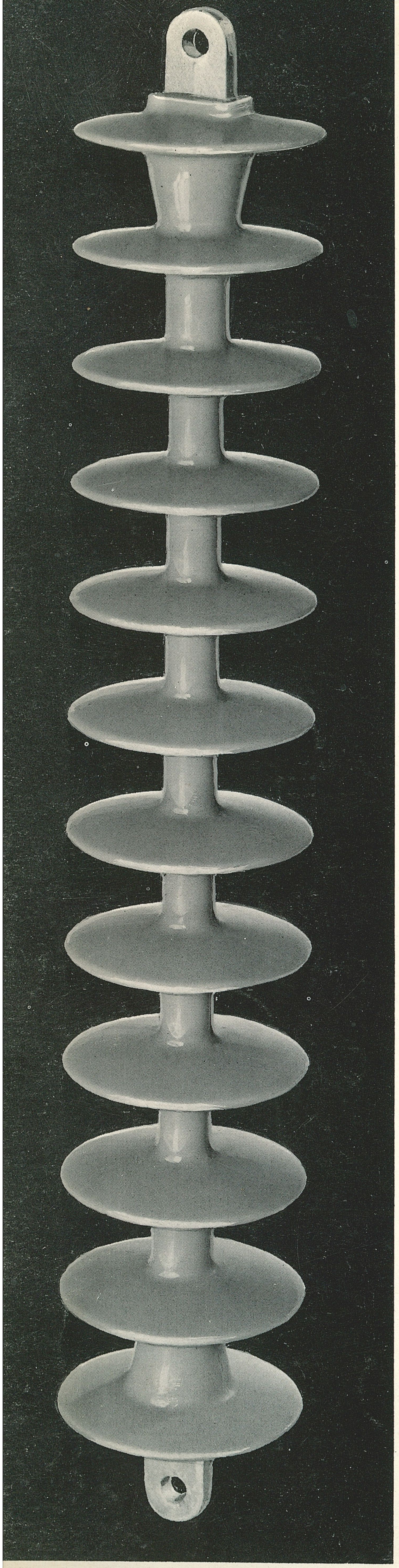
Designed to check cement line corrosion and its attendant problems, the Lokgard sleeve acts in two ways to reduce line maintenance and risk of failure in corrosive atmospheres. The ductile lead sleeve acts as a pressure "relief valve", compensating for pressure buildup and relieving stress on porcelain. More importantly, the lead sleeve actually inhibits corrosive action, significantly reducing buildup of corrosion deposits and checking erosion of the ball bolt.

This exclusive double protection reduces line maintenance in contaminated areas of salt air or industrial waste, and averts insulator failure, cracking, or explosion from corrosion buildup beneath the cement.

The Lokgard sleeve is available on all standard Locke suspension insulators as an optional, extra cost protection. For prices, contact your Insulator Department Representative or write direct.

SUSPENSION INSULATORS

GEPOL POLYMER INSULATORS



Developmental version of GEPOL insulator for 115 KV application.

Wet process porcelain has been used in suspension insulators from the beginning of the electric industry. It has had no serious challenges, because of its long life, high dielectric strength, imperviousness to chemicals, freedom from electrical tracking, and low materials cost. Nevertheless, the search for new materials, new designs, and new processes has continued.

Early in 1954, the General Electric Company initiated a program to determine if any of the new synthetic materials then becoming available offered potential improvements over porcelain for suspension insulators. Many different formulations were evaluated and discarded. Finally, in 1957, a modified epoxy-type polymer was developed which appeared to meet the basic requirements, and to have certain unique advantages.

Prototype suspension insulators using the material were subjected to exhaustive tests, including electrical flashover, time load, impact, thermal shock, high current, and salt fog. Limited service tests in four field locations were then undertaken. Now, five years later, the field test units show no harmful effects and have given perfect performance.

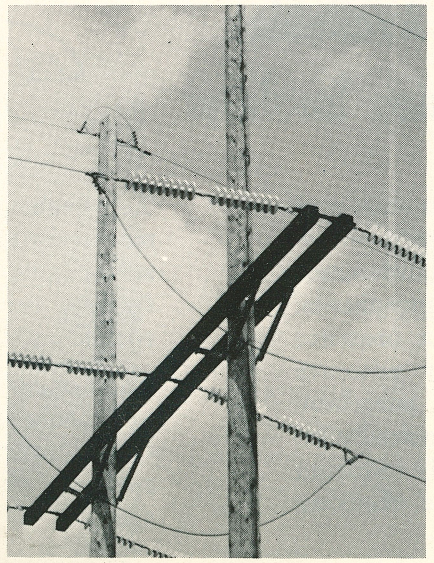
On the basis of this limited success, the next step is being taken. A pilot plant has been set up in the Insulator Department's Baltimore factory. GEPOL (General Electric Polymer) suspension units are being produced for a massive field test to obtain exposure to every conceivable weather, contamination, and operating condition. Cooperating utilities around the world will help determine the application limitations of this radically new insulator, and in the process obtain a better measure of its ultimate life characteristics.

Some of the advantages so far identified are:

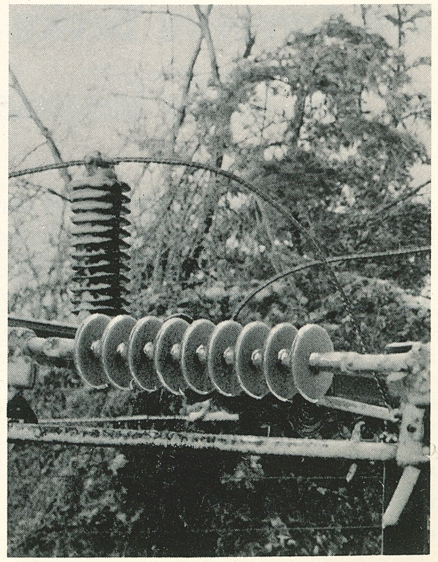
- Less Weight—70% weight reduction means lower transportation, handling and installation costs.
- Smaller Profile—30% reduction in diameter means improved appearance and smaller target size.
- Design Versatility—offers new opportunities for customized approaches to EHV design.
- High Impact Strength—promises less damage in manufacture, transportation, erection and service.
- Improved Thermal Shock Resistance—suggests wide field of application for these new materials.
- Low Metal Content—means reduction of corona and near-elimination of corrosion.

These potential advantages await the successful conclusion of the broad scale field testing now being carried out. For information on how you can participate in the GEPOL polymer insulator test program, contact your Insulator Department sales representative.

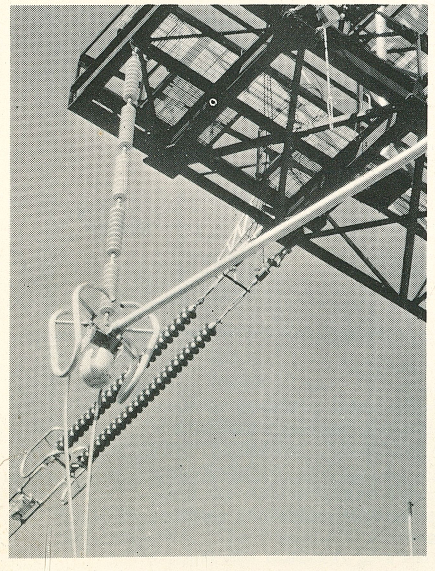
Over four years of high summer temperatures and electrical storms on 115 KV line of Baltimore Gas & Electric Co.



Wind, weather, and extreme temperatures for more than four years on lines of New England Electric System.

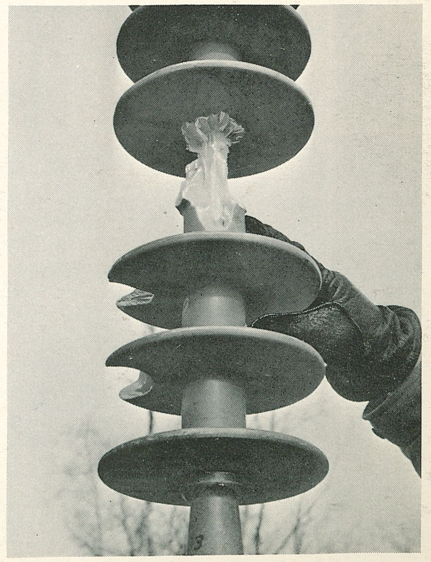


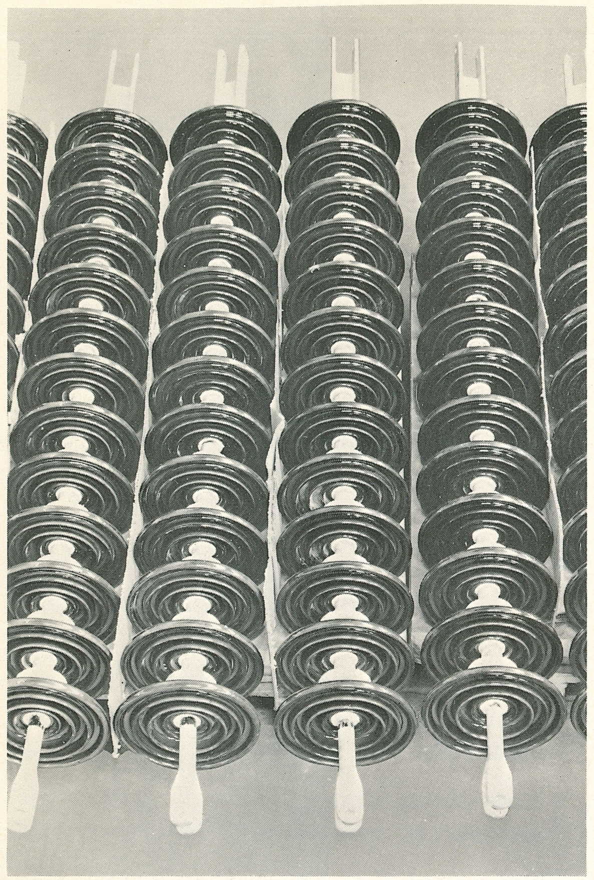
500 to 525 KV insulated without trouble at General Electric Project EHV installation at Pittsfield, Mass.



The sea just yards away . . . corona activity greatly reduced on Florida Power and Light installation.

Even after direct hits with M-1 rifle fire at 50 ft., when tested, unit exceeded ultimate strength rating.





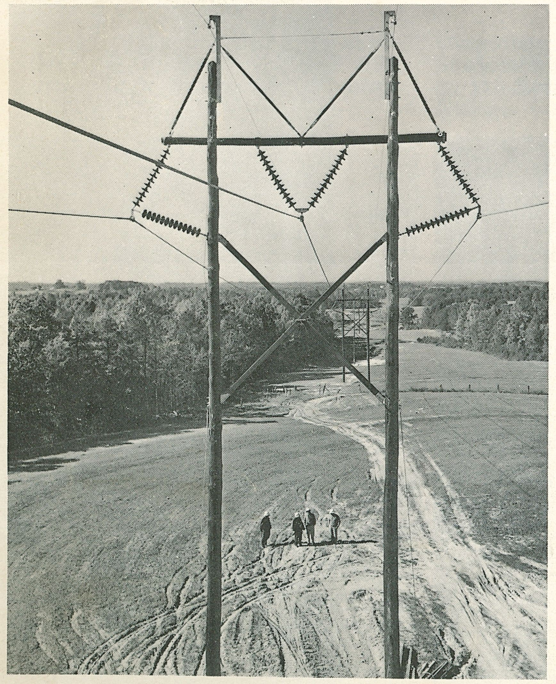
SUSPENSION INSULATORS

UNISPAR INSULATORS

The Locke Unispar Insulator is a rigid spar, or strut type insulator used to hold lines or jumpers in a fixed position by controlling swing in the horizontal arc. This application solves many design problems encountered in transmission line conversion, narrow rights-of-way, long jumpers, curved or turning rights-of-way, and radio and television interference from lightly loaded suspensions.

RESISTANCE TO GUNFIRE

The construction of the Locke Unispar Insulator offers extra benefits in the form of a high tolerance to accidental or malicious damage from rifle or shotgun fire. Constructed of individual shells and metal caps firmly joined for rigidity, each segment of the Unispar is protected from such damage. Instead of the complete rupture and failure which can be expected from a solid porcelain rod, damage will usually be restricted to a broken petticoat. Replacement then becomes a much more economical procedure of visual inspection and routine maintenance, rather than a costly emergency.



Locke Unispar Insulators solve dual problem of narrow right-of-way and high gunfire incident on 230KV lines of Duke Power. Horizontally mounted unit controls line swing to keep it within right-of-way and clear of tower, segmented construction of Unispar Insulators give best **protection against gunfire** in this heavily hunted area.

COMPARATIVE CATALOG NUMBERS

M&E Strength, Pounds	Connector	Shell Dia., Inches	Spacing, Inches	ASA Class	Present LOCKE Nos.	CHANCE	KNOX	LAPP	LINE MATERIAL	OHIO BRASS	PINCO	VICTOR
10,000	Clevis	4¼	6¼	—	16044		84212	6815		42399		814
			6¼	—	*16046	66160						
		6	5½	—	*16083							
			5½	52-1	16583	66200	86012	6605	NS5A1	32433	L1510	804
			5½	52-1	17583							
15,000	Clevis	3⁵⁄₁₆	5¾	—	18028					41799		
		7½	5¾	52-2	5875	66220	87512	9507		32435	L600	801
	Ball & Socket	9	5	—	15S408			9001				
			5¾	†52-3	15S409			9000	NS1A9			
	Clevis		5¾	†52-4	15S410			9100				
15,000 (FOG TYPE)	Ball & Socket	10½	6½	—	18134			46512		35230		960
			5¾	—	18135			43306				
			6½	—	**18168							
			5¾	—	**18169							
	Clevis		6½	—	18136			45805		35231		860
			5¾	—	18177							
20,000	Ball & Socket	10	5¾	†52-3	20S840			8200	NS1A3			
			5	—	20S845			8201				
	Clevis		5¾	†52-4	20S580			8100				
25,000 (FOG TYPE)	Ball & Socket	10½	6½	—	18234			48085		47460		
			5¾	—	18235			42244		47450		
	Clevis		6½	—	18236			45835		47465		
			5¾	—	18237							
30,000	Ball & Socket	10	5	—	30S254			5960				
			5¾	†52-5	30S255			5960A	NS1A7			
	Clevis		5¾	†52-6	30S257			2300				
40,000	B & S	10	5¾	—	40S360			61236				
					Obsolete LOCKE Nos.							
14,000	Ball & Socket	9	5	—	18408			9001		48058		
			5¾	—	18409		89022	9000	NS1A9	48008	L960	
	Clevis		5¾	—	18410		89012	9100		48019	L970	
15,000	Ball & Socket	10	5¾	52-3	1840	66255	81022	8200	NS1A3	32440	L1060	900
			5¾	52-3	18400	66256	91022	8200T	NS1A3	34500	L1060H	
			5	—	1845	66260	81042	8201	NS1A2	32436	L1260	901
			5	—	18405	66261	91042	8201T	NS1A2	40500	L1260H	
	Clevis		5¾	52-4	580	66250	81012	8100	NS2A2	32439	L1070	800
			5¾	52-4	5800	66251	91012	8100T	NS2A2	35301	L1070H	851
25,000	Ball & Socket	10	5	—	18254			5960		47400		
			5¾	52-5	18255	66267	71022	5960A	NS1A7	47410	L1570	
	Clevis		5¾	52-6	18257	66265	71012	2300	NS2A4	47415	L1500	
36,000	B & S	10	5¾	—	18360			61236		47610		

*Aluminum hardware **Stainless steel ball bolts

†Nos. 15S409 & 15S410 meet ASA standards for electrical characteristics. Nos. 20S840, 20S580, 30S255 and 30S257, in addition to meeting all requirements in ASA standards, give you a bonus in M & E strengths over standard 15,000 lb. and 25,000 lb. units.